Obstetric Hemorrhage: The Role of Hypertensive Disorders as a Risk Factor

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Johns Hopkins University
Maternal-Fetal Medicine
NO DISCLOSURES
Learning Objectives

1. Review risk factors for obstetric hemorrhage
2. Review definitions and management of hypertensive disorders of pregnancy
3. Describe alterations in management of obstetric hemorrhage when hypertensive disorders are present
Background: Hemorrhage and Hypertension

- Bread and butter obstetrics
- Most common complications of childbirth
- Responsible for so much morbidity and mortality
- Everyone should care about
  - Broad relevance
- Both have well-defined risk factors but we are still not good at predicting
Background: Obstetric hemorrhage

- Single most important cause of maternal death worldwide
- Responsible for half of all postpartum deaths in developing countries
- Direct cause of 13% of pregnancy-related maternal deaths in US

Maternal Mortality in Maryland

Most recent report (2014, on 2012 deaths):
- 14 pregnancy-related deaths
  - 1 from hemorrhage (7%)
  - 3 from HTN (21%)

HTN and PPH appear yearly as common causes of pregnancy-related deaths.

Between 2001-2011: 19 pregnancy related deaths due to hemorrhage in Maryland.
Background: Obstetric hemorrhage

- Gravid uterus at term receives 600cc/min
- Internal iliac artery divisions
- Extensive collateral circulation
  - Sheep model: occlusion leads to revascularization via external iliac and internal pudendal arteries
  - Retrograde flow and vascular dilatation
- Incredible propensity to maintain supply

Background: Obstetric hemorrhage

• No single satisfactory definition of PPH
• Traditionally: >500cc vaginal birth or >1L cesarean birth; problematic
  – Average volume lost at delivery approaches these amounts
  – Estimates of blood loss are notoriously inaccurate (underreported)

### Risk Factors for Postpartum Hemorrhage

- Prolonged labor
- Augmented labor
- Rapid labor
- History of postpartum hemorrhage
- Episiotomy, especially mediolateral
- Preeclampsia
- Overdistended uterus (macrosomia, twins, hydramnios)
- Operative delivery
- Asian or Hispanic ethnicity
- Chorioamnionitis


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Causes of Postpartum Hemorrhage

- Tone (atony): 80%
- Tissue (retained)
- Trauma (lacerations)
- Thrombolysis (coagulation defects)
Contributions to maternal death from various causes of obstetrical hemorrhage. Percentages are approximations because of different classification schemata used. DIC = disseminated intravascular coagulation. (Data from Al-Zirqi, 2008; Berg, 2010; Chichakli, 1999; Zwart, 2008.)
# Causes, risk factors of Obstetric hemorrhage

<table>
<thead>
<tr>
<th>Abnormal Placentaion</th>
<th>Uterine Atony</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placenta previa</td>
<td>Uterine overdistention</td>
</tr>
<tr>
<td>Placental abruption</td>
<td>Large fetus</td>
</tr>
<tr>
<td>Placenta accreta/increta/percreta</td>
<td>Multiple fetuses</td>
</tr>
<tr>
<td>Ectopic pregnancy</td>
<td>Hydramnios</td>
</tr>
<tr>
<td>Hydatidiform mole</td>
<td>Retained clots</td>
</tr>
<tr>
<td>Injuries to the Birth Canal</td>
<td>Labor induction</td>
</tr>
<tr>
<td>Episiotomy and lacerations</td>
<td>Anesthesia or analgesia</td>
</tr>
<tr>
<td>Forceps or vacuum delivery</td>
<td>Halogenated agents</td>
</tr>
<tr>
<td>Cesarean delivery or hysterectomy</td>
<td>Conduction analgesia with hypotension</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>Labor abnormalities</td>
</tr>
<tr>
<td>Previously scarred uterus</td>
<td>Rapid labor</td>
</tr>
<tr>
<td>High parity</td>
<td>Prolonged labor</td>
</tr>
<tr>
<td>Hypersimulation</td>
<td>Augmented labor</td>
</tr>
<tr>
<td>Obstructed labor</td>
<td>Chorioamnionitis</td>
</tr>
<tr>
<td>Intrauterine manipulation</td>
<td>Previous uterine atony</td>
</tr>
<tr>
<td>Midforceps rotation</td>
<td>Coagulation Defects—Intensify Other Causes</td>
</tr>
<tr>
<td>Breech extraction</td>
<td>Massive transfusions</td>
</tr>
<tr>
<td>Obstetrical Factors</td>
<td>Placental abruption</td>
</tr>
<tr>
<td>Obesity</td>
<td>Sepsis syndrome</td>
</tr>
<tr>
<td>Previous postpartum hemorrhage</td>
<td>Severe preeclampsia syndrome</td>
</tr>
<tr>
<td>Early preterm pregnancy</td>
<td>Acute fatty liver</td>
</tr>
<tr>
<td>Sepsis syndrome</td>
<td>Anticoagulant treatment</td>
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<tr>
<td>Vulnerable Patients</td>
<td>Congenital coagulopathies</td>
</tr>
<tr>
<td>Preeclampsia/eclampsia</td>
<td>Amniotic-fluid embolism</td>
</tr>
<tr>
<td>Chronic renal insufficiency</td>
<td>Prolonged retention of dead fetus</td>
</tr>
<tr>
<td>Constitutionally small size</td>
<td>Saline-induced abortion</td>
</tr>
</tbody>
</table>

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*Johns Hopkins Medicine*
ACOG Task Force on Hypertension in Pregnancy

• Changed terminology of hypertensive disorders
• Changed the diagnosis of PEC
  – Spot ratio
  – Growth restriction, proteinuria no longer criteria for “severe”
• Advised delivery of PEC and gHTN at 37 weeks
• Formalized aspirin recs
• Changed postpartum care
Classification of hypertensive disorders of pregnancy

- Preeclampsia-Eclampsia
- Gestational hypertension
  - BP elevation after 20 weeks gestation in the absence of proteinuria or systemic findings
- Chronic hypertension
  - Hypertension that predates pregnancy
- Chronic hypertension with superimposed preeclampsia
**TABLE E-1. Diagnostic Criteria for Preeclampsia**

| Blood pressure | • Greater than or equal to 140 mm Hg systolic or greater than or equal to 90 mm Hg diastolic on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with a previously normal blood pressure |
|               | • Greater than or equal to 160 mm Hg systolic or greater than or equal to 110 mm Hg diastolic, hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy |

and

| Proteinuria | • Greater than or equal to 300 mg per 24-hour urine collection (or this amount extrapolated from a timed collection) |
|            | • Protein/creatinine ratio greater than or equal to 0.3* |
|            | • Dipstick reading of 1+ (used only if other quantitative methods not available) |

Or in the absence of proteinuria, new-onset hypertension with the new onset of any of the following:

| Thrombocytopenia | • Platelet count less than 100,000/microliter |
| Renal insufficiency | • Serum creatinine concentrations greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease |
| Impaired liver function | • Elevated blood concentrations of liver transaminases to twice normal concentration |
| Pulmonary edema | |
| Cerebral or visual symptoms | |

* Each measured as mg/dL.
BOX E-1. Severe Features of Preeclampsia (Any of these findings)

- Systolic blood pressure of 160 mm Hg or higher, or diastolic blood pressure of 110 mm Hg or higher on two occasions at least 4 hours apart while the patient is on bed rest (unless antihypertensive therapy is initiated before this time)
- Thrombocytopenia (platelet count less than 100,000/microliter)
- Impaired liver function as indicated by abnormally elevated blood concentrations of liver enzymes (to twice normal concentration), severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by alternative diagnoses, or both
- Progressive renal insufficiency (serum creatinine concentration greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease)
- Pulmonary edema
- New-onset cerebral or visual disturbances
Risk factors for preeclampsia

**BOX 3-1. Risk Factors for Preeclampsia**

- Primigravity
- Previous preeclamptic pregnancy
- Chronic hypertension or chronic renal disease or both
- History of thrombophilia
- Multifetal pregnancy
- In vitro fertilization
- Family history of preeclampsia
- Type I diabetes mellitus or type II diabetes mellitus
- Obesity
- Systemic lupus erythematosus
- Advanced maternal age (older than 40 years)
Large multicenter RCT from the Netherlands
756 women with mild gHTN or PEC without severe features, singleton gestations 36-41 6/7 weeks
Allocated to IOL or expectant monitoring
1° outcome: composite of adverse maternal outcome (new onset severe PEC, HELLP, eclampsia, pulmonary edema, abruption)

HYPITAT
(HYpertension and Preeclampsia Intervention Trial At Term)

- **2° outcome**: neonatal morbidities, rate of cesarean section
- Induction of labor (vs. expectant management) associated with a significant reduction in composite adverse maternal outcome (RR 0.71, CI 0.59-0.86) but no differences in neonatal complications or cesarean delivery
  - Better maternal outcome **without** ↑c/s rate
HYPITAT
(Hypertension and Preeclampsia Intervention Trial At Term)

- Result based on difference in progression to severe diseases between IOL and expectant monitoring
- Basis upon which the new ACOG HTN recommendations are made!
- Incidental finding of 10% rate of PPH
  - Much higher than 0.4-1.3% in low-risk population
Secondary analysis

1° outcome: PPH (EBL >1L within 24h pp)

Results: 10.4% rate of PPH

Independent *antepartum* prognostic variables: preeclampsia (OR 1.5), age (0.96)

Independent *intrapartum* prognostic variables: GA at delivery, duration of dilatation stage, episiotomy

Take-home point: gHTN or mild PEC is associated with ↑ risk of PPH

Why is HTN such a big deal in the setting of obstetric hemorrhage?

- Lack of “normal” volume expansion
- Markers of well-being are unreliable
- Methergine
- Double risk for organ systems
- Coincident risk factors
- Induction
- Magnesium
- Platelets
Plasma volume expansion

- Normal physiologic changes of pregnancy: 40% ↑ plasma volume, 25% ↑ red cell mass
- Women with severe PEC or eclampsia are more vulnerable to hemorrhage because they do not have a normally expanded blood volume.
  - Mean ↑ above nonpregnant volume of only 10% in eclamptic women
- Starting off “behind the eight ball” – don’t have the normal buffer for PPH

Changes in hemodynamic parameters in preeclampsia

- **Decreased**: cardiac output, pulmonary capillary wedge pressure, plasma volume
- **Increased**: peripheral vascular resistance, vascular sensitivity to endogenous pressor peptides, vascular permeability leading to albumin loss from intravascular space

Markers of well-being

- Traditional markers of maternal well-being from PPH are unreliable or misleading
  - Women with PEC may become “normotensive” despite remarkable hypovolemia.
  - Hemoglobin reflects hemoconcentration not absence of anemia

ATLS (Advanced Trauma Life Support) Classification

Table 1: Classification of haemorrhagic shock (ATLS manual American College of Surgeons).

<table>
<thead>
<tr>
<th>Class of haemorrhagic shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>Blood loss (mL)</td>
</tr>
<tr>
<td>Blood loss (% blood volume)</td>
</tr>
<tr>
<td>Pulse rate (per minute)</td>
</tr>
<tr>
<td>Blood pressure</td>
</tr>
<tr>
<td>Pulse pressure (mm Hg)</td>
</tr>
<tr>
<td>Respiratory rate (per minute)</td>
</tr>
<tr>
<td>Urine output (mL/hour)</td>
</tr>
<tr>
<td>Central nervous system/mental status</td>
</tr>
</tbody>
</table>

Methergine

- Methylergonovine
  - Ergot derivative; ↑tone, rate, amplitude of uterine muscles → tetanic contraction
  - PO, IM form; IV only in life-threatening emergencies and must be given over ≥60 sec; can cause sudden HTN and CVA
  - Hypertension is contraindication
  - Intense vasoconstriction: peripheral vascular ischemia, gangrene, CAD/MI
Preeclampsia affects all maternal organ systems
  – Renal system is particularly at risk
  – ↓ GFR (32%) and ↓ ERPF (effective renal plasma flow, 24%) from normal late pregnant values
  – GFR recovers within 1w of delivery, ERPF more slowly
  – Proteinuria and HTN make take 2y to disappear
    • Implies importance of duration of exposure to endothelial injury
Severe hemorrhage can compromise all organ systems
Coincident risk factors

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**Risk Factors for Preeclampsia**
- Primiparity
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- Obesity
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- Advanced maternal age (older than 40 years)

ACOG-SMFM Obstetric Care Consensus: Safe Prevention of the Primary Cesarean

• May see longer second stages and inductions
  – ↑ risk of PPH

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Induction and hemorrhage

- France: among low-risk women, regardless of method, IOL associated with ↑ risk of PPH (AOR 1.22, 95%CI 1.04–1.42) over spontaneous labor.
- Norway: Compared with spontaneous labor, PPH risk was ↑ for IOL(OR 1.71; 95% CI 1.56–1.88)
- Argentina, Uruguay: severe PPH associated with IOL (AOR 2.00, CI 1.30-3.09),

Magnesium sulfate

- **Anticonvulsant**
  - Blocks peripheral neuromuscular transmission
  - Prevents/alleviates vasospasm by acting as a competitive Ca++ antagonist

- **Attenuates (antagonizes!)** maternal systemic vascular responses to endogenous vasopressors in the setting of hypotension and hypovolemia
  - Blunts the hypertensive response

• CDC study of pregnancy-related mortality in US 1991-1997

• Leading causes of maternal death:
  – Hemorrhage, hypertensive disorder, PE, AFE, infection, pre-existing chronic conditions
  – Four-fold ↑ risk of pregnancy-related death for black women
  – ↑ Risks for older women and women with no prenatal care

Joint Commission existing requirements:

- **National Patient Safety Goal 16 (recognize and respond to changes in a patient’s condition)** is most applicable to the care of women during labor and birth. During an extensive review of the National Patient Safety Goals during 2009, Goal 16 was deemed better suited as a standard and was moved to the 2010 standards for hospitals and critical access hospitals. The Provision of Care, Treatment and Services standard, PC.02.01.19, requires the hospital to:
  - Have a process for recognizing and responding as soon as a patient’s condition appears to be worsening.
  - Develop written criteria describing **early warning signs** of a change or deterioration in a patient’s condition and when to seek further assistance.
  - Based on the hospital’s **early warning criteria**, have staff seek additional assistance when they have concerns about a patient’s condition.
  - Inform the patient and family how to seek assistance when they have concerns about a patient’s condition.

- [http://www.jointcommission.org/assets/1/18/SEA_44.PDF](http://www.jointcommission.org/assets/1/18/SEA_44.PDF)
Joint Commission suggested actions (6):

• 2. Identify specific triggers for responding to changes in the mother’s vital signs and clinical condition and develop and use protocols and drills for responding to changes, such as hemorrhage and pre-eclampsia. Use the drills to train staff in the protocols, to refine local protocols, and to identify and fix systems problems that would prevent optimal care.

• http://www.jointcommission.org/assets/1/18/SEA_44.PDF
Reinventing the wheel

Maternal Safety

Overview

The Council on Patient Safety in Women's Health Care (the Council) proposes to support the further development and implementation of Patient Safety Bundles for obstetric hemorrhage, severe hypertension in pregnancy, and venous thromboembolism prevention in pregnancy.

Find out more about the National Partnership for Maternal Safety

Severe Maternal Morbidity

Learn the process for reviewing severe maternal morbidity events, including information about who should review the event, when to review and how to review. Download easy-to-use forms to expedite your reporting processes.

Download the SMM reporting forms

Hemorrhage Bundle

Find out how to be prepared to handle obstetric hemorrhage events by reviewing the Hemorrhage Bundle. Learn about readiness steps, recognition and prevention, response strategies and more.

Download the Hemorrhage Bundle
COUNCIL ON PATIENT SAFETY
IN WOMEN’S HEALTH CARE
safe health care for every woman

About Us

Mission
Continually improve patient safety in women’s health care through multidisciplinary collaboration that drives culture change

Vision
Safe health care for every woman

Purpose
The Council on Patient Safety in Women’s Health Care’s purpose is to reduce harm to patients by fostering:

- Investigation to better understand the causation of harm
- Programs and tools to implement patient safety initiatives
- Education to promote patient safety
- Dissemination of patient safety information
- A health care culture of respect, transparency, and accountability
The National Partnership for Maternal Safety

Mary E. D’Alton, MD, Elliott K. Main, MD, M. Kathryn Menard, MD, and Barbara S. Levy, MD

- Collaborative, broad-based initiative
- 3 priority bundles for the most common preventable causes of maternal death and severe morbidity
- 3 unit-improvement bundles for OB services

Box 1. Key Priorities in Maternal Safety

Core Patient Safety Bundles
- Obstetric hemorrhage
- Severe hypertension in pregnancy
- Venous thromboembolism prevention in pregnancy

Supplemental Patient Safety Bundles
- Maternal Early Warning Criteria: criteria to identify maternal patients who require urgent bedside evaluation
- Facility Review: case review packages for facility-based, miniroot cause analysis for use in all cases of severe maternal morbidity and mortality
- Family and Staff Support: recommendations for support of patients, families, and staff who experience a severe maternal event

• 93% of all hemorrhage-related deaths considered potentially preventable

• Common preventable errors:
  – Underrecognition of blood loss
  – Lack of appropriate attention to clinical signs of hemorrhage and associated hypovolemia
  – Failure to act decisively with lifesaving interventions
  – Failure to restore blood volume in a timely manner

• Comprehensive hemorrhage protocols have been shown to improve patient safety and reduce use of blood products

Recommends the following for all US birthing facilities:

- Standard obstetric hemorrhage protocol and event checklist
- Hemorrhage kit or cart with appropriate medication and equipment
- Partnership with local blood bank for rapid and sustained availability of blood products
- Universal use of active management of third stage of labor

Advancing California Maternity Care
Through Data-Driven Quality Improvement

What’s New!
Registration is now open for participation in the California Partnership for Maternal Safety. To register, email Valerie Cape at vcape@cmqcc.org. Next steps will then be sent.

Infographic: Pregnancy Complications can Increase Risk for Heart Disease developed in partnership with Sister To Sister and CDPH.

Download the Improving Health Care Response to Preeclampsia: A California Quality Improvement Toolkit

CMQCC is devoted to eliminating preventable maternal death and injury and promoting equitable maternity care in California by bringing resources, tools, measures, and quality improvement techniques to providers, administrators, and public health leaders. This is a long term collaborative effort of many organizations and individuals (see about us for more information) with sponsorship of the California Department of Public Health (Maternal, Child and Adolescent Health Program), the California Perinatal Quality Care Collaborative (CPQCC), California HealthCare Foundation (CHCF) and the Centers for Disease Control. We are over 250 clinicians, public health leaders, key payors and public representatives all devoted to improving childbirth outcomes.

Current Priority Initiatives:

California Maternal Data Center (CMDC)
The California Maternal Data Center (CMDC) is a statewide initiative to generate rapid-cycle performance metrics on maternity care services. The program is designed to facilitate hospital quality improvement activities and service-line management in a way that is low burden, low cost and high value for hospital participants. Interested hospitals can learn more about participation in the For Hospitals section OR visit our Demonstration Site to experience the Maternal Data Center for yourself! Hospitals demonstrating their commitment to monitoring and improving the quality of perinatal care are CMDC Quality Leaders

California Partnership for Maternal Safety (CPMS)
Why is California so important?

- 2012: 3,952,841 births
  - 503,755 from California

Findings can serve as a model for the entire US

CMQCC devoted to eliminating preventable maternal death and injury and promoting equitable maternity care

- http://www.jointcommission.org/assets/1/18/SEA_44.PDF
• OB Hemorrhage Toolkit – 2010
• Free download, 166 pages
  – Compendium of Best Practices
  – Obstetric Hemorrhage Care Guidelines
  – Hospital Level Implementation Guide

  • https://www.cmqcc.org/ob_hemorrhage
OBSTETRIC HEMORRHAGE CARE SUMMARY: FLOW CHART FORMAT

**Pre-Admission**
- Identify patients with special consideration: Placenta previa/accreta, Bleeding disorder, or those who decline blood products
  - Follow appropriate workups, planning, preparing of resources, counseling and notification

**Time of admission**
- Screen All Admissions for hemorrhage risk:
  - Low Risk, Medium Risk and High Risk

**Stage 0**
- All Births
  - All women receive active management of 3rd stage
    - Oxytocin IV infusion or 10 Units IM
    - Vigorous fundal massage for 15 seconds minimum

**Blood Loss**
- Vaginal Birth:
  - >500 ml Vaginal
  - >1000 ml CS
  - Stage 1: Activate Hemorrhage Protocol
    - Order Type & Crossmatch 2 Units PRBCs if not already done

**Stage 1**
- Activate Hemorrhage Protocol
  - Increased bleeding
    - Ongoing Cumulative Blood Loss Evaluation
      - >500 ml Vag: >1000 ml CS
      - >15% Vital Sign change or:
        - HR > 110, BP > 85/45
        - O2 Sat < 95%, Clinical St
      - Standard Postpartum Management
        - Fundal Massage

**Stage 2**
- Sequentially Advance through Medications & Procedures
  - Vaginal Birth:
    - Bimanual Fundal Massage
    - Retained POC: Dilation and Curettage
    - Lower segment/Implantation site/Atony: Intrauterine Balloon
    - Laceration/Hematoma: Packing, Repair as Required
    - Consider IR (if available & adequate experience)
  - Cesarean Birth:
    - Continued Atony: B-Lynch Suture/Intrauterine Balloon
    - Continued Hemorrhage: Uterine Artery Ligation

**Blood Loss**
- >1000-1500 ml
  - Unresponsive Coagulopathy:
    - After 10 Units PBRCs and full coagulation factor replacement, may consider rFactor VIIa
    - To OR (if not there):
      - Activate Massive Hemorrhage Protocol
      - Mobilize Massive Hemorrhage Team
      - TRANSFUSE AGGRESSIVELY
      - RBC:FFP:Plts → 6:4:1 or 4:4:1

**Stage 3**
- Conservative Surgery
  - B-Lynch Suture/Intrauterine Balloon
  - Uterine Artery Ligation
  - Hypogastric Ligation (experienced surgeon only)
  - Consider IR (if available & adequate experience)

**Controlled**
- HEMORRHAGE CONTINUES
  - Yes: Fertility Strongly Desired
  - NO: Definitive Surgery
  - Hysterectomy

Verifying Type & Screen on prenatal record:
- If positive antibody screen on prenatal or current labs (except low level anti-D from Rhogam), Type & Crossmatch 2 Units PBRCs

California Maternal Quality Care Collaborative (CMQCC), Hemorrhage Taskforce (2009): visit: www.CMQCC.org for details
This project was supported by Title V funds received from the State of California Department of Public Health, Center for Family Health; Maternal, Child and Adolescent Health Division
### Admission Hemorrhage Risk Factor Evaluation

<table>
<thead>
<tr>
<th>Low (Clot only)</th>
<th>Medium (Type and Screen)</th>
<th>High (Type and Cross)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No previous uterine incision</td>
<td>Prior cesarean birth(s) or uterine surgery</td>
<td>Placenta previa, low lying placenta,</td>
</tr>
<tr>
<td>Singleton pregnancy</td>
<td>Multiple gestation</td>
<td>Suspected placenta accreta or percreta</td>
</tr>
<tr>
<td>≤4 previous vaginal births</td>
<td>&gt;4 previous vaginal births</td>
<td>Hematocrit &lt;30 AND other risk factors</td>
</tr>
<tr>
<td>No known bleeding disorder</td>
<td>Chorioamnionitis</td>
<td>Platelets &lt;100,000</td>
</tr>
<tr>
<td>No history of PPH</td>
<td>History of previous PPH</td>
<td>Active bleeding (greater than show) on admit</td>
</tr>
<tr>
<td></td>
<td>Large uterine fibroids</td>
<td>Known coagulopathy</td>
</tr>
<tr>
<td></td>
<td>Estimated fetal weight greater than 4 kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Morbid obesity (BMI &gt;25)</td>
<td></td>
</tr>
</tbody>
</table>

*If admitted patients are started on magnesium sulfate they are at higher risk of postpartum hemorrhage.*

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- [https://www.cmqcc.org/ob_hemorrhage](https://www.cmqcc.org/ob_hemorrhage)
APPENDIX E.3. METHODS FOR DEVELOPING TRAINING AND TOOLS FOR QUANTITATIVE MEASUREMENT OF BLOOD LOSS

Recommended methods for ongoing quantitative measurement of blood loss:

1. Formally estimate blood loss by recording percent (%) saturation of blood soaked items with the use of visual cues such as pictures/posters to determine blood volume equivalence of saturated/blood soaked pads, chux, etc.
2. Formally measure blood loss by weighing blood soaked pads/chux
3. Formally measure blood loss by collecting blood in graduated measurement containers

Quantifying blood loss by weighing (see images at right and below)
- Establish dry weights of common items
- Standardize use of pads
- Build weighing of pads into routine practice
- Develop worksheet for calculations

Quantifying blood loss by measuring (see image below right)
- Use graduated collection containers (C/S and vaginal deliveries)
- Account for other fluids (amniotic fluid, urine, irrigation)

Establish Dry Weights

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight in Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Bedside, 1½ chux</td>
<td>398</td>
</tr>
<tr>
<td>1½ pads perfed, 1 small</td>
<td></td>
</tr>
<tr>
<td>2 pads perfed, 2 small</td>
<td></td>
</tr>
<tr>
<td>Small Chux (1½ x 2½ inch)</td>
<td>22</td>
</tr>
<tr>
<td>Large Chux (2½ x 4 inch)</td>
<td>26</td>
</tr>
<tr>
<td>Large Perfed (peach backing)</td>
<td>30</td>
</tr>
<tr>
<td>Small Perfed (peach backing)</td>
<td>15</td>
</tr>
<tr>
<td>Side Pack Perfed</td>
<td>172</td>
</tr>
<tr>
<td>Cotton Towel (soft)</td>
<td>70</td>
</tr>
<tr>
<td>Vag Packing (C/S Pack)</td>
<td>44</td>
</tr>
<tr>
<td>Rayon Sponge</td>
<td>13</td>
</tr>
</tbody>
</table>

Procedure:
- Weigh all bloody items in grams
- Subtract dry weights in grams
- Remaining weight in grams = ml blood loss

1 gram = 1 ml

Under Buttocks Drapes

- 300 ml
- 900 ml

Training Tools

Posters

18 X 18 inch Dry Lap Sponges
- 25 ml saturates about 50% area
- 50 ml saturates about 75% area
- 75 ml saturates entire surface
- 100 ml will saturate and drip

Used with kind permission of Bev VanderWall, CNS
**OB Hemorrhage Medication Kit: Available in L&D and Postpartum Floor**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitocin 20 units per liter NS</td>
<td>1 bag</td>
</tr>
<tr>
<td>Hemabate 250 mcg/ml</td>
<td>1 ampule</td>
</tr>
<tr>
<td>Cytotec 200mg tablets</td>
<td>5 tabs</td>
</tr>
<tr>
<td>Methergine 0.2 mg/ml</td>
<td>1 ampule</td>
</tr>
</tbody>
</table>

**PYXIS/refrigerator**

- 1 Forceps, Ferris-Smith
- 2 Forceps with Teeth, 6"
- 1 Forceps, Russian 6"
- 2 Forceps, Adson with Teeth
- 1 Forceps, Tissue, Smooth, 7"
- 2 Kocher, Straight, 8"
- 6 Forceps, Heaney, Curved, 8 1/4"
- NH, Mayo Hegar, 8"
- 4 Sponge Stick, 9 1/2"
- 1 Scissor, Jorgensen, Curved, 9"
- 1 Scissors, bandage 7"
- 1 Scissors, curved dissecting, Metzenbaum
- 1 Scissors, Mayo, curved
- 1 Scissors, sharp/blunt, Straight, 5 1/2"
- 1 Scissors, Curved Metzenbaum 12"
- 1 Scissors, Mayo Straight 11"
- 1 Scissors, Mayo Curved 11"
- 1 Knife Handle #3
- 1 Knife Handle #4
- 1 Knife Handle #3, Long
- 1 Retractor, Kelly, large
- 1 Retractor, Deaver, Large, 3" x 12"
- 1 Retractor, Deaver, Medium
- 2 Retractor, Med/Large Richardson
- 1 Retractor, Balfour Blades
- 2 Retractor, Goulet, 7 1/2"
- 1 Suction, Yankauer Tip
- 1 Suction, Pool Tip

**OB Hemorrhage Cart: Recommended Instruments**

- Set of vaginal retractors (long right angle; long weighted speculum
- Sponge forceps (minimum: 2)
- Sutures (for cervical laceration repair and B-Lynch)
- Vaginal Packs
- Uterine balloon
- Banjo curetes, several sizes
- Long needle holder
- Uterine forceps
- Bright task light on wheels; behind ultrasound machine

Diagrams depicting various procedures (e.g. B-Lynch, uterine artery ligation, Balloon placement)

**OB Hemorrhage Medication Kit: Available in L&D and Postpartum Floor**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitocin 20 units per liter NS</td>
<td>1 bag</td>
</tr>
<tr>
<td>Hemabate 250 mcg/ml</td>
<td>1 ampule</td>
</tr>
<tr>
<td>Cytotec 200mg tablets</td>
<td>5 tabs</td>
</tr>
<tr>
<td>Methergine 0.2 mg/ml</td>
<td>1 ampule</td>
</tr>
</tbody>
</table>

**OB Hemorrhage Tray: Available on Postpartum Floor**

- IV start kit
- 18 gauge angiocath
- 1 liter bag lactated Ringers
- IV tubing
- Sterile Speculum
- Urinary catheter kit with urimeter
- Flash light
- Lubricating Jelly
- Assorted sizes sterile gloves
Simulation scenarios

SAMPLE SCENARIO #1: ABRUPTIO PLACENTAE
Leslie Casper, MD

SCENARIO: A 22 year old gravida 4 para 3303 Caucasian woman carrying a singleton pregnancy at 35 weeks estimated gestational age presents to the emergency room with vaginal bleeding. She has had limited prenatal care and she reports that she is approximately 36 weeks estimated gestational age by dates. Her records indicate she is carrying a singleton pregnancy in the vertex presentation. Her past medical history is uncomplicated, she has no allergies, and she takes no medications other than prenatal vitamins. She admits to smoking one-half pack of cigarettes per day. Her prenatal labs are not available. She states that her pregnancy has been uncomplicated with the exception of occasional spotting in the last trimester. She is uncertain if she has experienced rupture of membranes. An external fetal monitor is in place.

SAMPLE SCENARIO #2: PLACENTA PREVIA
Leslie Casper, MD

SCENARIO: A 21 year old gravida 2 para 1100 Caucasian woman presents at 37 weeks estimated gestational age to Labor and Delivery in early labor with the onset of contractions approximately one hour ago. She has had intermittent prenatal care starting at 12 weeks estimated gestational age. Her records indicate she is carrying a singleton pregnancy in the vertex presentation. Her past medical history is uncomplicated, she has no allergies, and she takes no medications other than prenatal vitamins. She admits to smoking less than one-half pack per day of cigarettes. Her prenatal labs are negative and her pregnancy has been uncomplicated except for intermittent spotting in the last six weeks. An external fetal monitor is in place.
Simulation scenarios

**Simulation and Drill: Educational Tool #3.**

**Sample Drill Scenario #3: Hemorrhage, Hypotension after Delivery**

**Hemorrhage versus Anaphylaxis**
Used with permission of Paul Preston, MD

**Briefing for team**
Mrs. Jones is a wonderful lady—it’s painful to see her having such an awful labor. 38YO, G2P1, induced for moderate pre-eclampsia. On mag and pit. Prior section for breech, really wants vag delivery. Slow labor all night, minimal sleep. CBC, labs—compatible with moderate pre-eclampsia, not HELLP. Finally got epidural 2 hours ago, now calling RN for something. If asked, no other major illness or known allergy, normal height and weight, last BP was 150/82, last HR 110, last cervical check 4 cm.

---

**Simulation and Drill: Educational Tool #4.**

**Sample Scenario #4: Atonic Uterus and Postpartum Hemorrhage (12)**
Used with permission from Martin P. Eason, MD, JD
• Multisciplinary approach

• Once activated, blood bank personnel provide blood products at predefined ratio without questioning the liberation of such products based on laboratory values

• Protocol continues until it is inactivated by surgeon either because bleeding has been controlled OR patient dies
• “Massive”
  – Anticipated need to replace $\geq 50\%$ blood volume within $2\text{h}$, OR
  – Ongoing bleeding after transfusion of $4\text{U}$ PRBC within short period of time (1-2h)
The Role of Massive Transfusion Protocols in Obstetrics

Luis D. Pacheco, MD¹,²  George R. Saade, MD¹  Maged M. Costantine, MD¹  Steven L. Clark, MD³  Gary D.V. Hankins, MD¹

Table 1  Massive Transfusion Protocol in Obstetrics

<table>
<thead>
<tr>
<th>Round</th>
<th>PRBC</th>
<th>FFP</th>
<th>Platelets</th>
<th>Cryoprecipitate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>6 U</td>
<td>6 U</td>
<td>6 U</td>
<td>10 U</td>
</tr>
<tr>
<td>Round 2</td>
<td>6 U</td>
<td>6 U</td>
<td></td>
<td>20 U</td>
</tr>
<tr>
<td>Round 3</td>
<td></td>
<td></td>
<td>Recombinant activated factor VII (40 µg/kg)⁴</td>
<td></td>
</tr>
<tr>
<td>Round 4</td>
<td>6 U</td>
<td>6 U</td>
<td>6 U</td>
<td>10 U</td>
</tr>
<tr>
<td>Round 5</td>
<td>6 U</td>
<td>6 U</td>
<td></td>
<td>10 U</td>
</tr>
<tr>
<td>Round 6</td>
<td></td>
<td></td>
<td>Recombinant activated factor VII (40 µg/kg)</td>
<td></td>
</tr>
</tbody>
</table>

Adapted with permission from: Pacheco LD, Saade GR, Gei AF, Hankins GD. Cutting-edge advances in the medical management of obstetrical hemorrhage. Am J Obstet Gynecol 2011;205:526–532.⁴

Consider activating the protocol when massive hemorrhage is expected and/or in patients with ongoing bleeding despite receiving 4 U of PRBC within a short period of time (1–2 h). Once activated, blood bank personnel will continue preparing blood products until the protocol is inactivated by the surgical team. After round 6, if not inactivated, the protocol will start again from round 1. PRBC, packed red blood cells; FFP, fresh frozen plasma.

⁴The utilized dose of recombinant activated factor VII is based on local expert opinion.
Authors theorize that it isn’t the ratio but the timely multidisciplinary intervention triggered when protocol is activated.

Activation alerts everyone on the team to the seriousness and critical nature of the situation.

Aggressive interventions (lines, warming) follow.

Improves communication between surgical team and blood bank.

Commonly, experienced surgeons make themselves “available to help”
• PRBC:FFP:platelets
• 6:4:1

• If bleeding continues:
• 4:4:1

• https://www.cmqcc.org/ob_hemorrhage
• 60% of maternal deaths resulting from hypertension are potentially preventable

• Key errors:
  – Failure to adequately control blood pressure
  – Failure to recognize HELLP syndrome
  – Failure to adequately diagnose and treat pulmonary edema

Emergent Therapy for Acute-Onset, Severe Hypertension During Pregnancy and the Postpartum Period

ABSTRACT: Acute-onset, severe systolic hypertension; severe diastolic hypertension; or both can occur in pregnant women or women in the postpartum period. Introducing standardized, evidence-based clinical guidelines for the management of patients with preeclampsia and eclampsia has been demonstrated to reduce the incidence of adverse maternal outcomes. Individuals and institutions should have mechanisms in place to initiate the prompt administration of medication when a patient presents with a hypertensive emergency. Once the hypertensive emergency is treated, a complete and detailed evaluation of maternal and fetal well-being is needed with consideration of, among many issues, the need for subsequent pharmacotherapy and the appropriate timing of delivery.
Box 1. Order Set for Severe Intrapartum or Postpartum Hypertension Initial First-Line Management With Labetalol*

- Notify physician if systolic blood pressure (BP) measurement is greater than or equal to 160 mm Hg or if diastolic BP measurement is greater than or equal to 110 mm Hg.
- Institute fetal surveillance if undelivered and fetus is viable.
- If severe BP elevations persist for 15 minutes or more, administer labetalol (20 mg intravenously [IV] over 2 minutes).
- Repeat BP measurement in 10 minutes and record results.
- If either BP threshold is still exceeded, administer labetalol (40 mg IV over 2 minutes). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 10 minutes and record results.
- If either BP threshold is still exceeded, administer labetalol (80 mg IV over 2 minutes). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 10 minutes and record results.
- If either BP threshold is still exceeded, administer hydralazine (10 mg IV over 2 minutes). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 20 minutes and record results.
- If either BP threshold is still exceeded, obtain emergency consultation from maternal–fetal medicine, internal medicine, anesthesia, or critical care subspecialists.
- Give additional antihypertensive medication per specific order.
- Once the aforementioned BP thresholds are achieved, repeat BP measurement every 10 minutes for 1 hour, then every 15 minutes for 1 hour, then every 30 minutes for 1 hour, and then every hour for 4 hours.
- Institute additional BP timing per specific order.

*Please note there may be adverse effects and contraindications.


Box 2. Order Set for Severe Intrapartum or Postpartum Hypertension Initial First-Line Management With Hydralazine*

- Notify physician if systolic blood pressure (BP) is greater than or equal to 160 mm Hg or if diastolic BP is greater than or equal to 110 mm Hg.
- Institute fetal surveillance if undelivered and fetus is viable.
- If severe BP elevations persist for 15 minutes or more, administer hydralazine (5 mg or 10 mg intravenously [IV] over 2 minutes).
- Repeat BP measurement in 20 minutes and record results.
- If either BP threshold is still exceeded, administer hydralazine (10 mg IV over 2 minutes). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 20 minutes and record results.
- If either BP threshold is still exceeded, administer labetalol (20 mg IV over 2 minutes). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 10 minutes and record results.
- If either BP threshold is still exceeded, administer hydralazine (10 mg IV over 2 minutes) and obtain emergency consultation from maternal–fetal medicine, internal medicine, anesthesia, or critical care subspecialists.
- Give additional antihypertensive medication per specific order.
- Once the aforementioned BP thresholds are achieved, repeat BP measurement every 10 minutes for 1 hour, then every 15 minutes for 1 hour, then every 30 minutes for 1 hour, and then every hour for 4 hours.
- Institute additional BP timing per specific order.

*Please note there may be adverse effects and contraindications.

Anti-hypertensives

- **Hydralazine**: hypotension
- **Labetalol**: neonatal bradycardia; avoid in women with asthma, heart disease and CHF
- **Nifedipine**: associated with ↑maternal HR and overshoot hypotension
  - New addition to the ACOG Committee Opinion

---

**Box 3. Order Set for Severe Intrapartum or Postpartum Hypertension Initial First-Line Management With Oral Nifedipine**

- Notify physician if systolic blood pressure (BP) is greater than or equal to 160 mm Hg or if diastolic BP is greater than or equal to 110 mm Hg.
- Institute fetal surveillance if undelivered and fetus is viable.
- If severe BP elevations persist for 15 minutes or more, administer nifedipine (10 mg orally).
- Repeat BP measurement in 20 minutes and record results.
- If either BP threshold is still exceeded, administer nifedipine capsules (20 mg orally). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 20 minutes and record results.
- If either BP threshold is still exceeded, administer nifedipine capsule (20 mg orally). If BP is below threshold, continue to monitor BP closely.
- Repeat BP measurement in 20 minutes and record results.
- If either BP threshold is still exceeded, administer labetalol (40 mg intravenously over 2 minutes) and obtain emergency consultation from maternal–fetal medicine, internal medicine, anesthesia, or critical care subspecialists.
- Give additional antihypertensive medication per specific order.
- Once the aforementioned BP thresholds are achieved, repeat BP measurement every 10 minutes for 1 hour, then every 15 minutes for 1 hour, then every 30 minutes for 1 hour, and then every hour for 4 hours.
- Institute additional BP timing per specific order.

*Please note there may be adverse effects and contraindications.

Capsules should be administered orally and not punctured or otherwise administered sublingually.

• Preeclampsia Toolkit – 2014
• Free download, 159 pages
  – Compendium of Best Practices
  – Preeclampsia Care Guidelines
  – Hospital Level Implementation Guide

• https://cmqcc.org/resources/2824
# Preeclampsia Early Recognition Tool (PERT)

<table>
<thead>
<tr>
<th>ASSESS</th>
<th>NORMAL (GREEN)</th>
<th>WORRISOME (YELLOW)</th>
<th>SEVERE (RED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness</td>
<td>Alert oriented</td>
<td>- Agitated/confused</td>
<td>- Unresponsive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Drowsy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Difficulty speaking</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>None</td>
<td>- Mild headache</td>
<td>- Unrelieved headache</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Nausea, vomiting</td>
<td></td>
</tr>
<tr>
<td>Vision</td>
<td>None</td>
<td>- Blurred or impaired</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Temporary blindness</td>
<td></td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>100-139</td>
<td>140-159</td>
<td>≥160</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>50-89</td>
<td>90-105</td>
<td>≥105</td>
</tr>
<tr>
<td>HR</td>
<td>61-110</td>
<td>111-129</td>
<td>≥130</td>
</tr>
<tr>
<td>Respiration</td>
<td>11-24</td>
<td>25-30</td>
<td>&lt;10 or &gt;30</td>
</tr>
<tr>
<td>SOB</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>O2 Sat (%)</td>
<td>≥95</td>
<td>91-94</td>
<td>≤90</td>
</tr>
<tr>
<td>Pain: Abdomen or Chest</td>
<td>None</td>
<td>- Nausea, vomiting</td>
<td>- Nausea, vomiting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Chest pain</td>
<td>- Chest pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Abdominal pain</td>
<td>- Abdominal pain</td>
</tr>
<tr>
<td>Fetal Signs</td>
<td>Category I, Reactive NST</td>
<td>Category II</td>
<td>IUGR, Non-reactive NST</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Category III</td>
<td></td>
</tr>
<tr>
<td>Urine Output (mL/h)</td>
<td>≥50</td>
<td>30-49</td>
<td>≤30 (in 2 hrs)</td>
</tr>
<tr>
<td>Proteinuria (Level of proteinuria is not an accurate predictor of pregnancy outcome)</td>
<td>Trace</td>
<td>≥+1**</td>
<td>≥300mg/24 hours</td>
</tr>
<tr>
<td>Platelets</td>
<td>&gt;100</td>
<td>50-100</td>
<td>&lt;50</td>
</tr>
<tr>
<td>AST/ALT</td>
<td>&lt;70</td>
<td>&gt;70</td>
<td>&gt;70</td>
</tr>
<tr>
<td>Creatinine</td>
<td>&lt;0.8</td>
<td>0.9-1.1</td>
<td>&gt;1.2</td>
</tr>
<tr>
<td>Magnesium Sulfate Toxicity</td>
<td>DTR +1 Respiration 16-20</td>
<td>Depression of palmar reflexes</td>
<td>Respiration &lt;12</td>
</tr>
</tbody>
</table>

**YELLOW = WORRISOME**
Increase assessment frequency

- ≥1 Triggers TO DO:
  - Notify provider
  - Notify charge RN
  - In-person evaluation
  - Order lab tests
  - Obtain magnesium sulfate
  - Supplemental oxygen

- **Physician should be made aware of worsening or new-onset proteinuria**

**RED = SEVERE**

- Trigger: 1 of any type listed below

<table>
<thead>
<tr>
<th>TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Immediate evaluation</td>
</tr>
<tr>
<td>- Transfer to higher acuity level</td>
</tr>
<tr>
<td>- 1:1 staff ratio</td>
</tr>
</tbody>
</table>

  - **Awareness**
    | Consider Neurology consult |
  - **Headache**
    | Consider CT scan |
  - **Visual**
    | Consider SAH/intracranial hemorrhage |

  - **BP**
    | Labetalol/hydralazine in 30 min |
    | In-person evaluation |
    | Magnesium sulfate loading or maintenance infusion |

  - **Chest Pain**
    | Consider CT angiogram |

  - **Respiration**
    | O2 at 10 L per rebreather mask |
  - **SOB**
    | O2 at pulmonary edema |
  - **O2 SAT**
<pre><code>| Chest x-ray |
</code></pre>
<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose/Delivery</th>
</tr>
</thead>
</table>
| Magnesium 20 grams/500 ml bag                  | IV (Use Magnesium Sulfate Continuous Infusion under L&D protocol in Alaris Pump Library):  
  *Initial (Loading Dose)*: 4-6 g (100 ml – 150 ml) over 20 minutes  
  *Maintenance Dose*: 1-2 g/hour (25 ml/hr – 50 ml/hr) continuous infusion |
| Labetalol 100 mg/20 ml vial                    |  
  *Initial*: Draw 4 ml from the vial.  
  20 mg (4 ml) IV bolus followed by 40 mg (8 ml) if not effective within 10 minutes; then 80 mg (16 ml) every 10 minutes (maximum total dose of 300 mg/60 ml) |
| Hydralazine 20 mg/ml vial                      |  
  *Initial*: Draw 0.25 ml from the vial.  
  5-10 mg (0.25-0.5 ml) doses IV every 15-20 minutes |
| Esmolol 100 mg/10 ml vial (By Anesthesiologists ONLY) |  
  1-2 mg/kg (0.1-0.2 ml/kg) IV over 1 minute |
| Propofol 10 mg/ml, 20 ml vial (By Anesthesiologists ONLY) |  
  30-40 mg (3-4 ml) IV bolus |
| Calcium gluconate 1000 mg/10 ml vial           |  
  1000 mg/10 ml IV over 2-5 minutes |
| Labetalol 200 mg tablets                        |  
  200 mg PO and repeated in 30 minutes if needed |
| Nifedipine 10 mg PO                             |  
  10 mg PO in 30 minutes if needed |
| Supply contents                                 |  
  3 ml, 10 ml, and 20 ml syringes, appropriate needles and appropriate tubing sets |

Kindly used with permission of Stanford University Medical Center and Gillian Hilton, MD, 2013.
Eclampsia Algorithm

Call for help:

1. Position patient in left lateral decubitus position
2. Establish open airway and maintain breathing
3. Check Oxygen level
4. Check blood pressure and pulse
5. Obtain IV access: 1 or 2 large-bore IV catheters

Magnesium Sulfate:
- 4-6 gram IV loading dose over 15-20 minutes; followed by a 2 gram/hour maintenance dose if renal function is normal

If the patient seizures again while on magnesium sulfate maintenance dose:

1. Maintain airway and oxygenation
2. Give a 2nd loading dose of magnesium sulfate 2 grams over 5 minutes
3. Observe for signs of magnesium toxicity

If patient has a recurrent seizure after a 2nd loading dose of magnesium sulfate consider the following:

1. Midazolam (versed) 1-2 mg IV (can repeat in 5-10 minutes) OR
2. Lorazepam (ativan) 4 mg IV over 2-5 minutes (can repeat in 5-15 minutes to maximum of 8 mg in 12 hours) OR
3. Diazepam (valium) 5-10 mg IV slowly (can repeat every 15 minutes up to 30 mg) OR
4. Phenytoin (dilantin) 1000 mg IV over 20 minutes
5. Monitor respiration and RPT, ECG and signs of magnesium toxicity. Phenytoin may cause QRS or QT prolongation

Resolution of seizures:
1. Maintain magnesium sulfate infusion until 24 hours after the last seizure or after delivery, whichever is later
2. Assess for any signs of neurologic injury, focal deficit, head imaging should be considered if neurologic injury is suspected
3. Once the patient is stabilized, preparations should be made for delivery. Mode of delivery is dependent upon clinical circumstances surrounding the pregnancy

Discontinuation of therapy:
Severe pre-eclampsia and eclampsia
24 hours after delivery or after last seizure

NOTE: Administration beyond 24 hours may be indicated if the patient shows no signs of improvement

NOTE: These recommendations can be modified for use as each institution requires.
Preeclampsia symptoms can be conveyed via a pictorial information sheet.13 (Note: This is available from the Preeclampsia Foundation for a modest shipping and handling fee. A Spanish version is also available.)

**Ask Your Doctor or Midwife**

**Preeclampsia**

**What Is It?**

Preeclampsia is a serious disease related to high blood pressure. It can happen to any pregnant woman.

**Risks to You**

- Seizures
- Stroke
- Organ damage
- Death

**Risks to Your Baby**

- Premature birth
- Death

**Signs of Preeclampsia**

- Stomach pain
- Headaches

- Feeling nauseous; throwing up
- Seeing spots

- Swelling in your hands and face
- Gaining more than 5 pounds in a week

**What Should You Do?**

Call your doctor right away. Finding preeclampsia early is important for you and your baby.

For more information go to www.preeclampsia.org

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Conclusions

1. Postpartum hemorrhage and hypertension are common complications of pregnancy that share common risk factors. They have a high risk of morbidity and mortality.
2. Hypertension is an important risk factor for postpartum hemorrhage.
3. Treatment of postpartum hemorrhage starts with prevention and must be modified in the setting of hypertension.
4. Diagnostic criteria and definitions of hypertensive disorders of pregnancy have changed recently as have treatment guidelines.
5. Your hospital should have: early warning criteria, hemorrhage drills, a massive transfusion protocol, protocols for emergent treatment of severe hypertension.
6. Extensive best-practices resources exist for hospital-level implementation of protocols for postpartum hemorrhage and hypertension.